# CITY OF SAN DIEGO:
# SUSTAINABLE ENERGY 2050 PLAN



## ABSTRACT

Solar Map Fact Sheet and Three Photovoltaic Case Studies with Energy and Financial Impact Analysis


Center for Sustainable Energy CALIFORNIA

U.S. DEPARTMENT OF ENERGY

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## San Diego Solar Map

## Background

The San Diego Solar Map is a Department of Energy (DOE) funded project to track and map solar photovoltaic (PV) and solar water heating (SWH) installations in the San Diego region (Figure 1). The map, developed by Critigen (formerly CH2MHill) with support from the City of San Diego Environmental Services Department (ESD) and California Center for Sustainable Energy (CCSE), was officially unveiled in July of 2009. The purpose of the map is to expand the use of solar technology in the San Diego region by providing tools and information to businesses and home owners and demonstrating its widespread adoption. To date, the San Diego Solar Map has had over 6,200 site visits from 63 countries, 43 states, and nearly 300 cities in California.

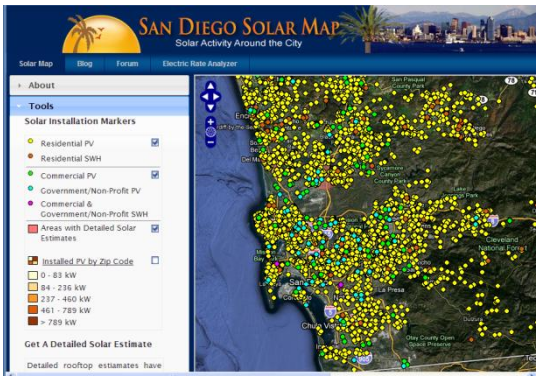


Figure 1 – Screenshot of Map
http://sd.solarmap.org

## Projects Statistics

At the time of its launch, the solar map consisted of nearly 6,000 projects from the state's PV rebate programs, including the Emerging Renewables Program (ERP), Self Generation Program (SGIP), California Solar Initiative (CSI) and regional solar water heating pilot program and other smaller programs. Since that time regional installations have expanded significantly and the project team is now in the process of updating the map with more than 2,000 additional projects bringing the total to more than 8,000, representing over 58.5 MW AC of capacity (Figure 2). The team is also developing a process for more frequent updates to the map so that residents, business and governments can have access to more up-to date information on installed capacity.

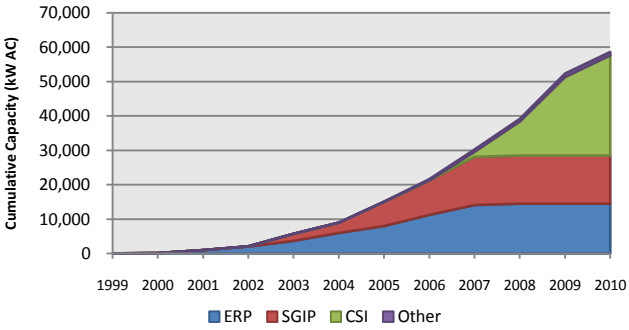


Figure 2 – Cumulative Capacity in SD Solar Map

## Site Enhancements

Since its launch, the Solar Map has gone through a series of enhancements, including the addition of an Electric Rate Analyzer, numerous new solar installations and Web 2.0 functionality. As part of its strategic marketing plan for the CSI, CCSE secured an additional $100,000 in ratepayer funding for further enhancements. With these funds, the project team plans to further expand

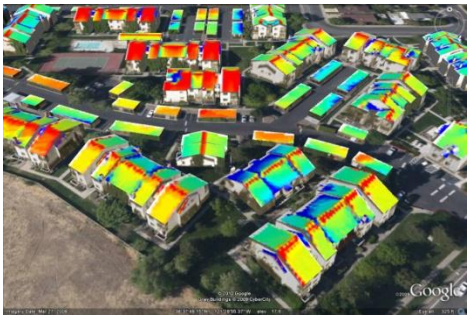


Figure 3 – PV Production Model

the site's Web 2.0 functionality and complete detailed assessments of PV generation potential at large commercial and government buildings in the San Diego Gas and Electric (SDG&E) service territory (Figure 3). Depending on costs, the team would like to extend this analysis to as many properties as possible, including smaller commercial buildings and residents.

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# Case Study I:

## A.O. Reed

## A.O. Reed (San Diego, CA)
## Solar America Initiative Case Study

**Technical Highlights**

- Existing facility retrofit
- Low load factor

**Energy Consumption Profile without PV**

- Standard tariff is SDG&E's AL-TOU
- Monthly Max Demand ranging from 35 kW in December to a high of 58 kW in August
- Energy consumption of 140,800 kWh per year
- The 2010 total annual bill would have been $25,194
- The energy and demand cost components of the overall electric bill were historically 55% and 45%, respectively.

**Key PV Project Outcomes**

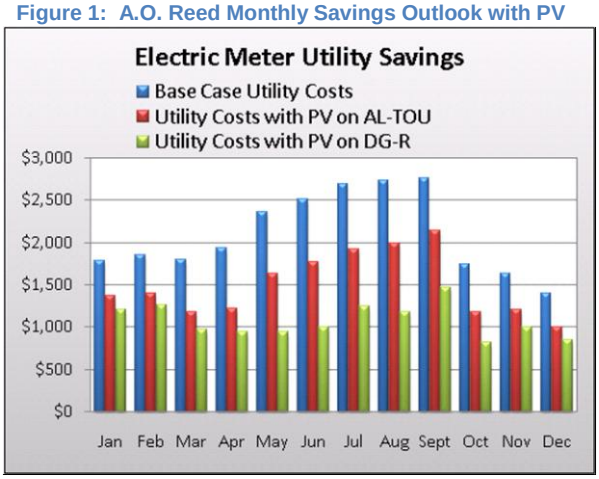
- 192 Kyocera KD210GX-LPU photovoltaic modules
- 6 SMA America SB6000US, 96% Efficient Inverters
- Expected production of 70,000 kWh annually
- Nominal capacity of 33 kW-AC
- 41.76 tons of equivalent CO2 offset annually
- Can generate approximately 70 RECs per year of photovoltaic energy
- Currently Offsets 51% of total energy usage (kWh) and 28% of total annual bill ($).
- Switching to SDG&E's DG-R tariff will save an additional 21% of total annual bill ($) for total savings of $12,334 in 2010

## Background

In 1914, Albert O. Reed opened a small plumbing and heating shop in San Diego and laid the groundwork for what today is one of the West's leading mechanical contractors. A.O. Reed & Co. provides engineering, installation, and maintenance services for a wide variety of plumbing and HVAC systems.

A.O. Reed's management recently executed a number of facility upgrades at their corporate offices to get more acquainted with developing and implementing a comprehensive resource conservation approach to their business practice and operations. The measures implemented are projected to save the company as much as 49% of its $25,194 annual utility bill. The resulting energy savings, coupled with the utility rate optimization, provides a deep reduction in energy costs, especially during summer when energy prices are highest. The value of "walking the walk" is tremendous for organizations inhabiting the energy industry. A.O. Reed understood the importance of facing and working through the similar issues and challenges to those a customer would face —enabling A.O. Reed to offer credible, practical solutions to clients looking to improve sustainability performance.

Figure 1: A.O. Reed Monthly Savings Outlook with PV




Developing an energy conservation plan and implementing the high value efficiency measures in coordination with solar energy generating equipment has helped A.O. Reed identify barriers their clients may face. The general sentiment at A.O. Reed was, 'We've learned how to plan better for energy efficiency and distributed generation integration issues.'

A.O. Reed also hired a facilities energy manger to oversee the implementation of energy efficiency, water conservation measures and onsite power generation. Having access to qualified personnel is

crucial to understanding a facility's load characteristics and to analyze and prioritize the typically long list of potential energy projects. A portfolio approach is usually the best strategy: assembling a group of measures that includes both efficiency and generation, and which together meet the financial and long-term sustainability goals of the organization.

Educating key staff on the various changes to design approach and implementation activities within the A.O. Reed organization supports the business-wide recognition of environmental benefits associated with reducing resource consumption. This appreciation has shifted the company's approach to sales to include more considerations of social responsibility. A.O. Reed sales staff and technicians are now broadly educated on energy efficiency, carbon footprints, and photovoltaic systems.

## Challenges

One major challenge A.O. Reed faced during development was in evaluating the various utility rates available to them from the local electric utility, San Diego Gas & Electric (SDG&E), in order to determine which tariff would result in the most bill savings. Becoming more acquainted with the relevant utility rate structures was a must. As a smaller business customer with no assigned account executive at the utility, A.O. Reed proceeded to educate themselves about the process, then completed the paperwork in house to file for the tariff change.

In SDG&E's territory, A.O. Reed changed from the standard commercial tariff (AL-TOU) to the DG-R tariff, a rate that shifts the customer cost burden associated with demand (kilowatts) to energy consumption (kilowatt-hours). SDG&E introduced the DG-R rate schedule in 2008 in response to a broadly-expressed customer need for tariff options that strongly reward clean on-site generation. Being able to reduce utility bills by offsetting kilowatt-hours is critical for variable, non-dispatchable renewable technologies like solar and wind.

A.O. Reed selected Sequoia Solar, a solar company with offices in La Jolla, CA, from a competitive bid process as the solar contractor that would appreciate A.O. Reed's history and forward progress. Cultural changes in the company appeared almost immediately and as a result, employees have organized to continue developing new conservation ideas to explore.

**Table 1: Aggregated Utility Cost Impact Summary (2010)**

| A.O. Reed | Energy | Demand | Total |
|---|---|---|---|
| **Project Performance Statistics** | | | |
| Total Energy (kWh) Consumed | | | 140,800 |
| Total Energy (kWh) Produced | | | 71,991 |
| kWh Difference (Cons. - Prod.) | | | 68,809 |
| **Pre-Project Costs** | | | |
| Base Case Utility Costs | $13,922 | $11,272 | $25,194 |
| **Post Project Costs** | | | |
| Bill Costs with PV on AL-TOU | $6,742 | $11,272 | $18,014 |
| Savings Compared to Base Case | $7,180 | $0 | $7,180 |
| Value of Energy Generated (VEG) | | | $0.0997 |
| Bill Costs with PV on DG-R | $9,068 | $3,802 | $12,870 |
| Savings Compared to Base Case | $4,854 | $7,470 | $12,324 |
| Value of Energy Generated (VEG) | | | $0.1712 |

## Annual Utility Cost Impact

The California Center for Sustainable Energy (CCSE) conducted a detailed analysis of PV system production and actual billing impacts

at A.O. Reed, as well as modeling of alternative scenarios. Table 1 presents top-level results, using 2010 energy prices, of the technical and financial assessments for the PV system installed behind the electric meter at A.O. Reed's central San Diego facility.

Under the standard commercial (AL-TOU) tariff, A.O. Reed would save around $7,000 annually in energy costs as a result of energy produced by their PV system.

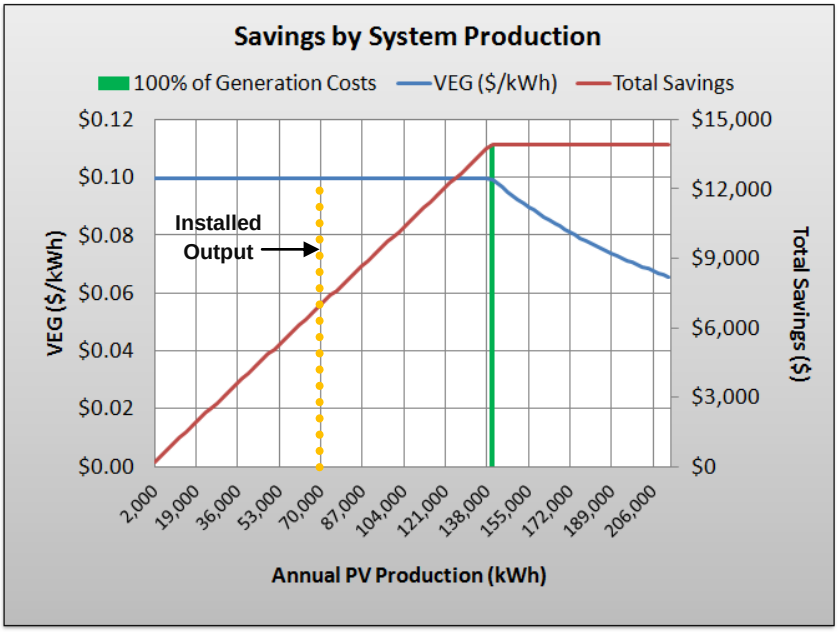
However, by switching to the DG-R tariff, they will save approximately $12,000 in energy costs during the 2010. That means $12,000 in savings is directly attributable to the strict solar, wind, and fuel cell eligibility defined by the DG-R tariff, and valuing those savings across the energy production of the system provides a way to measure and compare effectiveness. The AL-TOU value of energy generation (VEG) is $0.10 per kilowatt-hour of energy produced by the system during 2010 operations. Switching to the DG-R tariff will result in an additional +$0.07/kWh of value.

Jon Fortune with CCSE explains: "Those extra savings are critical to economic success since the net cost to install and operate a PV system is in the range of $0.11-$0.16 per kilowatt-hour in our market."

Figures 2 and 3 illustrate the relationship between the annual cumulative savings in dollars -- the red line that tracks with the right axis of the graph; and the VEG values -- the blue line that tracks with the left axis. Both indicators vary with the potential energy output of the PV system in kilowatt-hours, shown along the bottom axis.

In Figure 2, the VEG is fixed for AL-TOU up until the system offsets 100% of generation costs because the savings benefit in offsetting energy consumption alone is fixed by uniform energy commodity costs, with no savings attributable to demand. Demand costs are unavoidable on the AL-TOU due to the structure of the tariff and the nature of 15-minute interval demand measurement: For a PV system without energy storage such as this one, it is likely that cloud cover during one 15-minute interval will eliminate most or all of the potential demand savings. That is, PV will have at best a modest impact on demand charges.

**Figure 2: AL-TOU Impact Analysis**

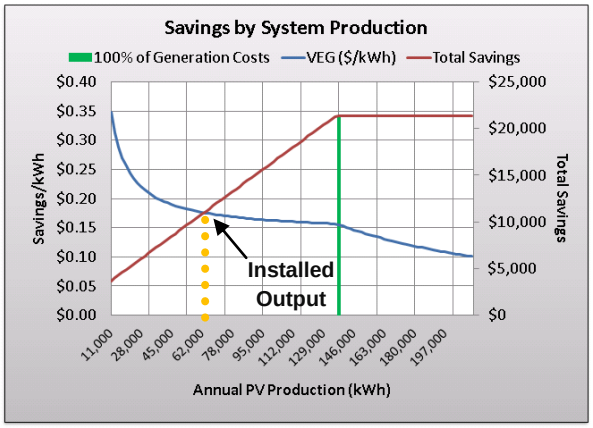



Switching to the DG-R tariff dramatically improves the VEG (total annual dollar savings/annual kWh production) shown in

Figure 3. The VEG is now highest where the capital investment is minimized.

The minimum system size to gain eligibility for the DG-R tariff is 10% of the maximum demand recorded in the previous 12 months; for A.O. Reed, this translated to a 6 kW-AC or greater PV, Wind, or Fuel Cell system. The VEG for a 6 kW-AC PV system producing 11,000 kWh would be $0.34/kWh, which translates to a rapid project payback.

**Figure 3: DG-R Impact Analysis**

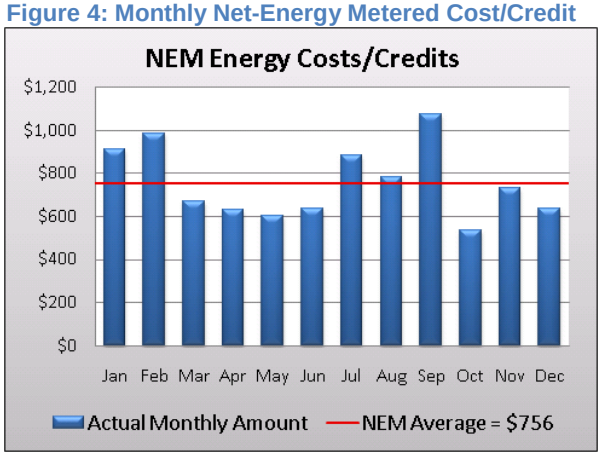



The base case utility bill composition for this facility consisted of 55% energy charges and 45% demand charges. When considering the impending switch to DG-R from AL-TOU, demand charges greater than 35% of the overall bill will result in a slowly decreasing VEG as the PV system production increases (shown in Figure 3).

Figure 4 shows post-installation monthly net electricity costs. Now that A. O. Reed has installed a PV system producing 72,000 kWh annually, average monthly energy costs are $562. A larger system capable of producing excess energy during any given month of consumption would result in energy bill credits, which would be applied during the annual true-up. A negative average would indicate excess credits, which typically harm project financial performance given the relatively low reimbursement value typically required of the utility.

The utility rate analysis performed shows A.O. Reed's PV system energy output is sized effectively to reduce energy consumption from the grid while generating valuable energy savings.

**Figure 4: Monthly Net-Energy Metered Cost/Credit**




Even apart from its obvious economic security and environmental benefits, this project is very clearly benefiting A.O. Reed's bottom line. The company is generating 50% of its electricity needs, at a lower cost than the energy displaced from the utility.

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## Case Study II:

# Innovative Cold Storage

## Innovative Cold Storage (San Diego, CA) Solar America Initiative Case Study

**Technical Highlights**

- New construction, LEED-Gold based design
- Moderate load factor

**Energy Consumption Profile without PV**

- Standard tariff is SDG&E's AL-TOU
- Monthly Max Demand ranging from 394 kW in February to a high of 465 kW in September
- Energy consumption of 2,060,462 kWh per year
- The total annual bill would have been $283,652
- The energy and demand cost components of the overall electric bill were historically 68% and 32%, respectively.

**Key PV Project Outcomes**

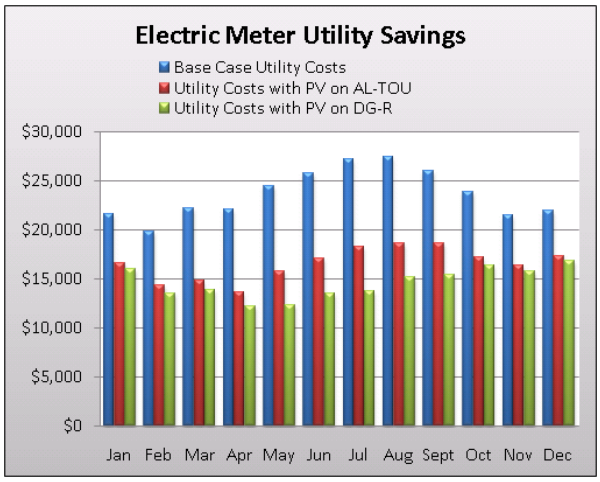
- 1874 SunPower 305-WHT-U photovoltaic modules
- 2 Xantrex GT-250-480, 96% Efficient Inverters
- Expected production of 856,450 kWh annually
- Nominal capacity of 450 kW-AC
- 496.74 tons of equivalent CO2 offset annually
- Can generate approximately 856 RECs per year of photovoltaic energy
- Currently Offsets 42% of total energy usage (kWh) and 38% of total annual bill ($).
- Switching to SDG&E's DG-R tariff saves an additional 8% of total annual bill ($), for total savings of $108,924 for 2010.

## Background

Innovative Cold Storage Enterprises, Inc. (ICE) provides a variety of cold storage services in San Diego, California. The company was founded by Mexican food provider Delimex and local firm Hamann Construction to supply Delimex and other food providers with quality frozen food storage. ICE recently completed the construction of a second freezer warehouse to provide up to 29,000 pallet spaces at temperatures between 0 and -20 degrees Fahrenheit at all times. Keeping all that space at sub-zero temperatures requires significant cooling capacity throughout the hot Southern California summers. ICE clearly had that in mind when they decided to design their second facility to satisfy US Green Building Council LEED-Gold certification requirements.

As co-founder and chief operator of the ICE facilities, Hamann Construction's commitment to energy conservation is evident from the level of system integration and detailed analysis that directed the new building design. As compared to structures built to conform to minimum code requirements, LEED-certified buildings are designed to reduce operating costs and increase asset value; conserve energy and water; be healthier and safer for occupants; reduce waste sent to landfills; and reduce harmful greenhouse gas emissions.

Figure 5: ICE Monthly Savings Outlook with PV




One critical system for the new facility is the state-of-the-art energy management system, which is able to monitor and control onsite energy consumption of this "always on" facility. Building operators can be notified immediately if there is an unexpected shift in power consumption that needs their attention. The system also monitors the performance of the photovoltaic (PV) system installed on the roof.

Another interesting aspect of this project is that ICE partnered with the local utility, San Diego Gas and Electric (SDG&E) by reserving a portion of their roof space for a second PV system owned and operated by SDG&E through its Sustainable Communities Program. While the energy produced by the SDG&E system does not decrease ICE's energy bill, the lease payment from the utility for use of the roof space does modestly improve ICE's bottom line and partnering with the utility created an economy of scale by bulk purchasing the solar generating equipment for both systems. ICE's PV system is projected to save the company as much as 38% of its $283,652 annual utility bill.

The energy savings coupled with utility rate optimization provides a deep reduction in energy costs, especially during summer when energy prices are highest. ICE's cold storage services require consumption of large quantities of energy, so even small measures add up to important cost savings. ICE addressed their large cooling need by incorporating energy efficient design measures combined with a PV system that produces 42% of their annual energy consumption. Because this is a newly constructed facility, the energy savings are being realized in 2010 and will continue throughout the life each building system.

## Highlights

Due to Hamann Construction's close ties with ICE, the design, project development, and construction moved easily through each phase of the project. Hamman Construction is an experienced designer and installer of PV systems who is knowledgeable about the federal and state incentive programs.

Designing a PV system for a new facility requires a clear understanding of the building, its systems and all anticipated operational characteristics. Building energy modeling software programs help designers fine-tune their energy use projections by calculating energy requirements under a wide variety of operating scenarios and calculating the facility's net energy needs over discrete periods of time.

ICE changed from the SDG&E's standard commercial tariff (AL-TOU) to the DG-R tariff, a rate that shifts the customer cost burden associated with demand (kilowatts) to energy consumption (kilowatt-hours). SDG&E introduced the DG-R rate schedule in 2008 in response to a broadly-expressed customer need for tariff options that strongly reward clean on-site generation. Being able to reduce utility bills by offsetting kilowatt-hours is critical for variable, non-dispatchable renewable technologies like solar and wind.

**Table 2: Aggregated Utility Cost Impact Summary (2010)**

| Innovative Cold Storage | Energy | Demand | Total |
|---|---|---|---|
| **Project Performance Statistics** | | | |
| Total Energy (kWh) Consumed | | | 2,060,462 |
| Total Energy (kWh) Produced | | | 856,449 |
| kWh Difference (Cons. - Prod.) | | | 1,204,013 |
| **Pre-Project Costs** | | | |
| Base Case Utility Costs | $193,389 | $90,263 | $283,652 |
| **Post Project Costs** | | | |
| Bill Costs with PV on AL-TOU | $108,256 | $90,263 | $198,519 |
| Savings Compared to Base Case | $85,133 | $0 | $85,133 |
| Value of Energy Generated (VEG) | | | $0.0994 |
| Bill Costs with PV on DG-R | $141,932 | $32,795 | $174,727 |
| Savings Compared to Base Case | $51,457 | $57,468 | $108,924 |
| Value of Energy Generated (VEG) | | | $0.1272 |

## Annual Utility Cost Impact

The California Center for Sustainable Energy (CCSE) conducted a detailed analysis of PV

system production and actual billing impacts at ICE, as well as modeling of alternative scenarios. Table 1 presents top-level results, using 2010 energy prices, of the technical and financial assessments for the PV system installed behind the electric meter at ICE's second San Diego facility.

Under the standard commercial (AL-TOU) tariff, ICE would save around $85,000 annually in energy costs as a result of energy produced by their PV system.

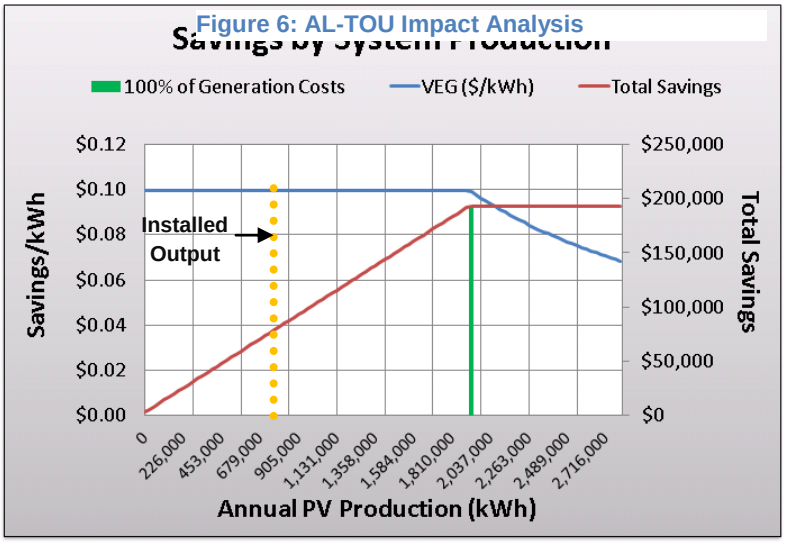
However, by switching to the DG-R tariff, they will save approximately $109,000 in energy costs during 2010. That means $24,000 in savings is directly attributable to the strict solar, wind, and fuel cell eligibility defined by the DG-R tariff, and valuing those savings across the energy production of the system provides a way to measure and compare effectiveness. The AL-TOU value of energy generation (VEG) is $0.10 per kilowatt-hour of energy produced by the system during 2010. Switching to the DG-R tariff will result in an additional +$0.03/kWh of value.

Jon Fortune with CCSE explains: "The key is getting the VEG up above the cost to install and operate a PV system over the life of that system. In San Diego, that's greater than $0.12/kWh in savings."

Figures 2 and 3 illustrate the relationship between the annual cumulative savings in dollars -- the red line that tracks with the right axis of the graph; and the 2010 VEG values -- the blue line that tracks with the left axis. Both indicators vary with the potential energy output of the PV system in kilowatt-hours, shown along the bottom axis.

In Figure 2, the VEG is fixed for AL-TOU up until the system offsets 100% of generation costs because the savings benefit in offsetting energy consumption alone is fixed by uniform energy commodity costs, with little to no savings attributable to demand. Even though maximum demand at ICE's facility will likely coincide with the hottest (and sunniest) hours of the year, demand risk with the AL-TOU is still relatively high due to the structure of the tariff and the nature of 15-minute interval demand measurement: For a PV system without energy storage, it is likely that cloud cover during one 15-minute interval will eliminate most or all of the potential demand savings**.** That is, PV will have at best a modest impact on demand charges if at all.

Figure 6: AL-TOU Impact Analysis




Switching to the DG-R tariff dramatically improves the VEG (total annual dollar savings/annual kWh production) shown in Figure 3. Under DG-R the VEG increases as the system size increases up until the point at which it fully offsets 100% of the site energy (kWh) costs through net-metering at around 1,900,000 kWh. However, a system should be sized to offset no more than 75% of the

annual energy costs (not to be confused with 75% of the energy kWh consumption)for the following reasons:

- Under AL-TOU, energy (kWh) is valued differently depending on when it is consumed or produced. It is not uncommon for PV to offset some percentage of energy that is less than the percentage energy costs it will reduce. For example, offsetting 70% of energy costs can happen with offsetting only 60% of kWh consumption.
- Creating headroom for future energy efficiency upgrades or load variability
- Annual weather variability translates into +/- 10% average energy output of the PV system

The minimum system size to gain eligibility for the DG-R tariff is 10% of the maximum demand recorded in the previous 12 months. For ICE, this would translate into to a 47 kW-AC or greater PV, Wind, or Fuel Cell system. Due to ICE's load profile and load factor, deriving benefit from the DG-R depends on the PV system offsetting relatively large amounts of on-site energy consumption. For example, while on the DG-R tariff, the VEG for a minimum sized 47 kW-AC PV system producing 84,580 kWh in 2010 would be $0.003 per kWh of energy produced, providing very little bill savings. In contrast, the VEG for a system producing 594,000 kWh per year or above is much higher, as is apparent in Figure 3.

The benefits of switching to DG-R from AL-TOU vary depending on the specific load characteristics of each customer; in general, however, those with relatively high demand charges will benefit from the rate change itself, regardless of the PV system size. For an individual customer considering a switch to DG-R from AL-TOU, demand charges greater than 35% of the overall bill will result in a VEG that decreases from the minimum eligible system size as the PV system production increases. Facilities incurring demand charges less than 35% of their total bill, such as ICE, will exhibit VEG progression similar to Figure 3. For ICE, the base case utility bill composition consisted of 68% energy charges and 32% demand charges.

**Figure 7: DG-R Impact Analysis**

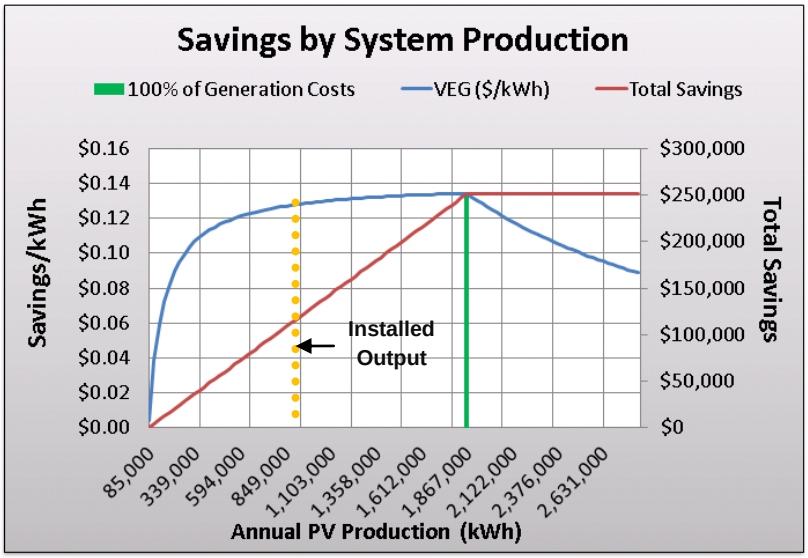
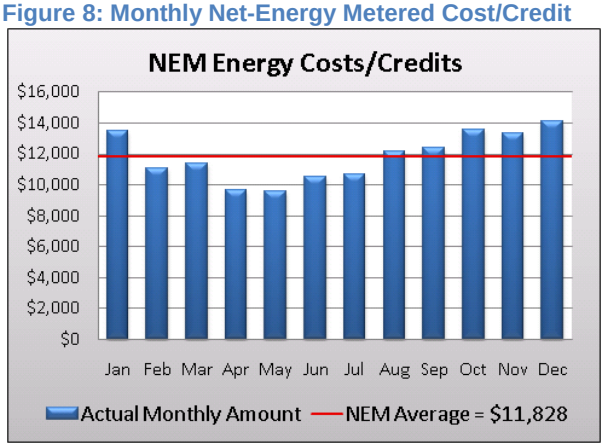



Figure 4 shows post-installation monthly net electricity costs. Now that ICE has installed a PV system producing 856,450 kWh annually, average monthly energy costs are $11,828. A larger system capable of producing excess energy during any given month of consumption would result in energy bill credits, which would be applied during the annual true-up. A negative average would indicate excess credits, which typically harm project financial performance given the relatively low reimbursement price typically paid by the utility.

The utility rate analysis performed shows ICE's PV system energy output is sized effectively to reduce energy consumption from the grid while generating valuable energy savings.

**Figure 8: Monthly Net-Energy Metered Cost/Credit**




ICE's partners made this project a showcase example of how to effectively address high energy needs with a comprehensive and integrated approach to energy efficiency and distributed generation. The company is generating 42% of its electricity needs, at a cost comparable to utility energy displaced by the system.

# Case Study III:

## Pfizer, Inc.

## Pfizer, Inc. (San Diego, CA)
## Solar America Initiative Case Study

**Technical Highlights**

- Existing facility retrofit
- Moderate load factor

**Energy Consumption Profile without PV**

- Standard tariff is SDG&E's AL-TOU
- Monthly Max Demand ranging from 285 kW in April to a high of 367 kW in August
- Energy consumption of 1,502,037 kWh per year
- The 2010 total annual bill would have been $220,133
- The energy and demand cost components of the overall electric bill were historically 66% and 34%, respectively.

**Key PV Project Outcomes**

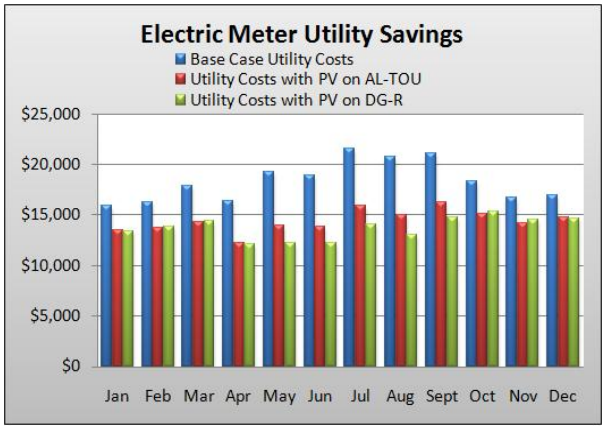
- 1,372 Sharp Solar ND208U1 photovoltaic modules
- 2 SatCon AE-135-60-PV-A, 95.5% Efficient Inverters
- Expected production of 414,138 kWh annually
- Nominal capacity of 240 kW-AC
- 240.20 tons of equivalent CO2 offset annually
- Can generate approximately 415 RECs per year of photovoltaic energy
- Currently Offsets 28% of total energy usage (kWh) and 25% of total annual bill ($).
- Switching to SDG&E's DG-R tariff saves an additional 6% of total annual bill ($) for total savings of $54,964 in 2010.

## Background

Pfizer Global Research and Development (Pfizer) is committed to resource conservation and views it as critical to reducing its environmental impact and improving its environmental performance. Pfizer has been named a US EPA Climate Leader and seeks to maintain this position, as well as continue its focus on using innovative alternatives to create cost savings and benefits for the community. To help meet this commitment, Pfizer La Jolla has taken a whole energy approach, not only installing the Pfizer La Jolla photovoltaic (PV) system, but also implementing energy efficiency measures and enrolling in San Diego County's "Demand Response Program", which helps save energy during critical peak summer days. Subsequently, Pfizer La Jolla has been recognized locally and awarded for their aggressive and successful energy conservation program.

Pfizer views the installation of the photovoltaic (PV) system at its La Jolla campus as also making good business sense: "Not only is this project the hallmark of good environmental practice, it also includes cost savings for the company such as tax credits, rebates, subsidies and other incentives for the use of green energy."[i]

**Figure 9: Pfizer Monthly Savings Outlook with PV**




According to Thomas Krzysik, Sourcing Manager for Construction and Facility Services for Pfizer Inc., "This project is a permanent educational opportunity for Pfizer and its staff." The project has not only provided Pfizer the opportunity to work through a PV project and gain first-hand experience, but also provides ongoing education fueled by real-world production and performance information. Continuous performance monitoring facilitates ongoing evaluation of the project's contribution to the company's operations. The knowledge and success gained during Pfizer's PV project at

their La Jolla offices has enabled a number of other renewable energy projects to move forward at the company. The project also had to conform to Pfizer's requirement of minimal impact, both initial and ongoing, to physical property and surrounding areas. Examples included limited roof penetrations, rooftop access pathways and protocols to protect sensitive equipment and maintenance systems that minimize water runoff from module cleaning. Pfizer staff developed operations and maintenance procedures prior to the project's implementation.

**Table 3: Pfizer La Jolla Aggregated Utility Cost Impact Summary (2010)**

| Pfizer | Energy | Demand | Total |
|---|---|---|---|
| **Project Performance Statistics** | | | |
| Total Energy (kWh) Consumed | | | 1,502,037 |
| Total Energy (kWh) Produced | | | 414,139 |
| kWh Difference (Cons. - Prod.) | | | 1,087,898 |
| **Pre-Project Costs** | | | |
| Base Case Utility Costs | $145,664 | $74,470 | $220,133 |
| **Post Project Costs** | | | |
| Bill Costs with PV on AL-TOU | $104,359 | $74,470 | $178,829 |
| Savings Compared to Base Case | $41,305 | $0 | $41,305 |
| Value of Energy Generated (VEG) | | | $0.0997 |
| Bill Costs with PV on DG-R | $140,044 | $25,125 | $165,170 |
| Savings Compared to Base Case | $5,619 | $49,344 | $54,964 |
| Value of Energy Generated (VEG) | | | $0.1327 |

## Annual Utility Cost Impact

The California Center for Sustainable Energy (CCSE) conducted a detailed analysis of PV system production and actual billing impacts at Pfizer, as well as modeling of alternative scenarios. In SDG&E's territory, Pfizer changed from the standard commercial tariff (AL-TOU) to the DG-R tariff, a rate that shifts the customer cost burden associated with demand (kilowatts) to energy consumption (kilowatt-hours). SDG&E introduced the DG-R rate schedule in 2008 in response to a broadly-expressed customer need for tariff options that strongly reward clean on-site generation. Being able to reduce utility bills by offsetting kilowatt-hours is critical for variable, non-dispatchable renewable technologies like solar and wind.

Table 1 presents top-level results, using 2010 energy prices, of the technical and financial assessments for the PV system installed behind the electric meter at Pfizer's La Jolla facility.

Under the standard commercial (AL-TOU) tariff, Pfizer would save around $41,000 annually in energy costs as a result of energy produced by their PV system. However, by switching to the DG-R tariff, they will save approximately $55,000 in energy costs in 2010. That means $14,000 in savings is directly attributable to the rate change itself.

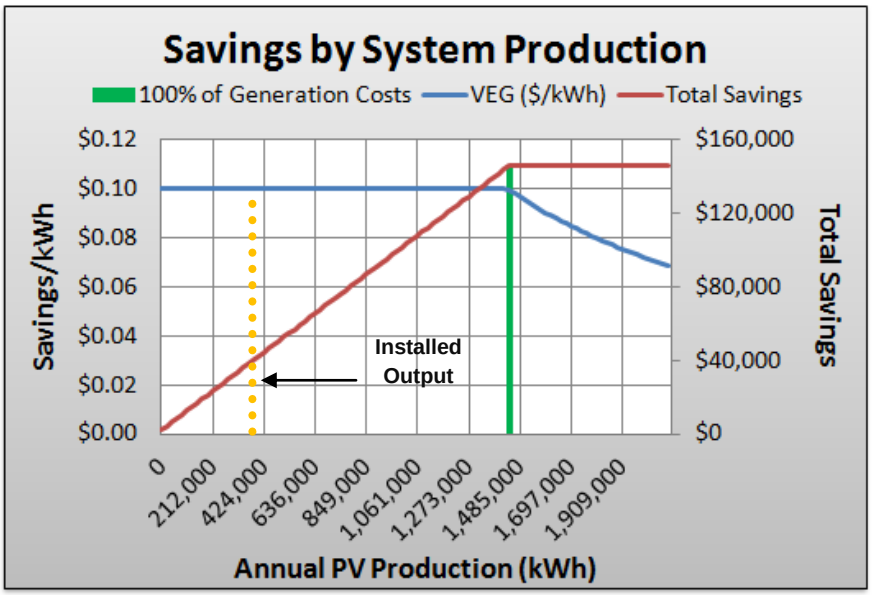
The AL-TOU value of energy generation (VEG) is $0.10 per kilowatt-hour of energy produced by the system in 2010. Switching to the DG-R tariff resulted in an additional +$0.03/kWh of value. Jon Fortune from CCSE explains: "Getting the VEG higher than $0.12/kWh is critical for project success in San Diego. Select the proper utility rate structure to leverage the net energy metering the benefits."

Figures 2 and 3 illustrate the relationship between the annual cumulative savings in dollars -- the red line that tracks with the right axis of the graph; and the 2010 VEG values -- the blue line that tracks with the left axis. Both

indicators vary with the energy output of the PV system in kilowatt-hours, shown along the bottom axis.

In Figure 2, the VEG is fixed for AL-TOU up until the system offsets 100% of generation costs because the savings benefit in offsetting energy consumption alone is fixed by uniform energy commodity costs, with no savings attributable to demand. Demand costs are unavoidable on the AL-TOU due to the structure of the tariff and the nature of 15-minute interval demand measurement: it is likely that cloud cover during one 15-minute interval will eliminate most or all of the potential demand savings**.** That is, PV will have at best a modest impact on demand charges.

Figure 10: Pfizer La Jolla AL-TOU Impact Analysis

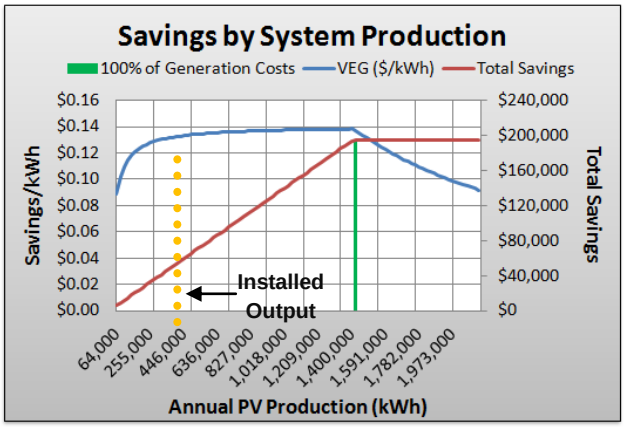



Switching to the DG-R tariff dramatically improves the VEG (total annual dollar savings/annual kWh production) shown in Figure 3. Under DG-R the VEG increases as the system size increases up until the point at which it fully offsets 100% of the site energy (kWh) costs through net-metering at around 1,400,000 kWh. However, a system should be sized to offset no more than 75% of the annual energy costs (not to be confused with 75% of the energy kWh consumption) for the following reasons:

- Under AL-TOU, energy (kWh) is valued differently depending on when it is consumed or produced. It is not uncommon for PV to offset some percentage of energy that is less than the percentage energy costs it will reduce. For example, offsetting 100% of energy costs can happen with offsetting only 94% of kWh consumption.
- Creating headroom for future energy efficiency upgrades or load variability
- Annual weather variability translates into +/- 10% average energy output of the PV system

The minimum system size to gain eligibility for the DG-R tariff is 10% of the maximum demand recorded in the previous 12 months. For Pfizer, this would translate into to a 47 kW-AC or greater PV, Wind, or Fuel Cell system. The VEG for a 47 kW-AC PV system producing 84,580 kWh in 2010 would be $0.003/kWh, providing very little benefit. However, the market value of the energy generated by systems producing 594,000 kWh per year and above is much higher, as is evident in Figure 3.

Figure 11: Pfizer La Jolla DG-R Impact Analysis




Facilities with relatively high demand charges are most likely to benefit from a rate shift from the AL-TOU to DG-R. Demand charges greater than 35% of the overall bill will result in an immediate savings from the rate change itself, even with relatively small PV systems. Facilities incurring demand charges less than 35% of their total bill, including Pfizer, will exhibit VEG progression similar to Figure 3. Pfizer's base case utility bill composition for this facility consisted of 66% energy charges and 34% demand charges.

Figure 12: Monthly Net-Energy Metered Cost/Credit

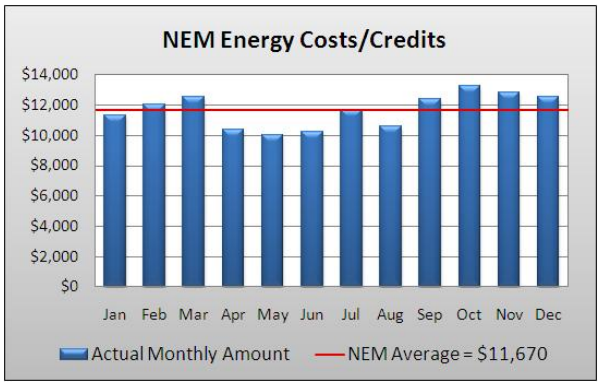



Figure 4 shows post-installation monthly net electricity costs. Now that Pfizer has installed a PV system producing 414,000 kWh annually, average monthly energy costs are $11,670. A larger system capable of producing excess energy during any given month of consumption would result in energy bill credits, which would be applied during the annual true-up. A negative average would indicate excess credits, which typically harm project financial performance given the relatively low price typically paid by the utility for that energy.

The utility rate analysis performed shows Pfizer's PV system energy output is sized effectively to reduce energy consumption from the grid while generating valuable energy savings. Pfizer's partners made this project a showcase example of how to effectively address high energy needs with a comprehensive approach to energy efficiency and distributed generation integration. The company is generating 42% of its electricity needs, at a cost lower than the utility company energy displaced by the system.

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[i] http://www.pfizer.com/responsibility/protecting_environment/case_studies_energy.jsp